

DIFFERENCES IN SENSITIVITY OF *EURYTEMORA AFFINIS* AND *PSEUDODIAPTOMUS FORBESI* TO CHLORPYRIFOS, PERMETHRIN AND BIFENTHRIN

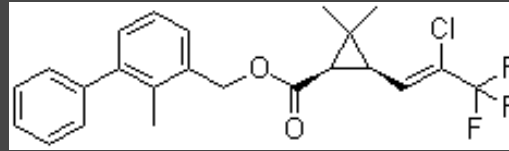
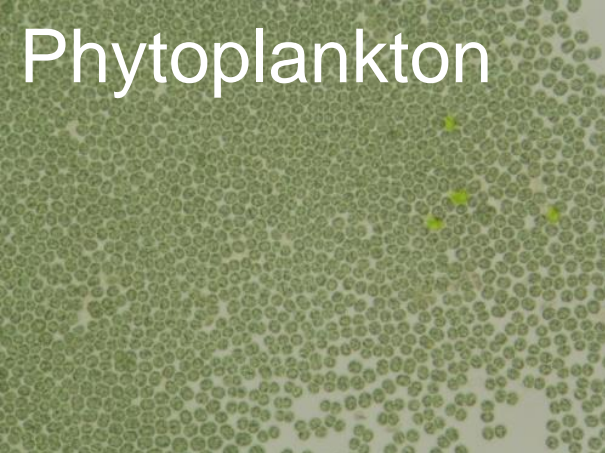
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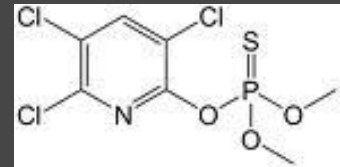
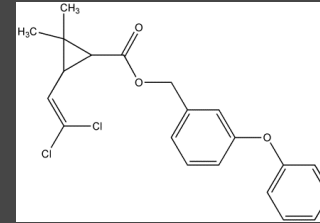
25 May 2010
IEP Workshop



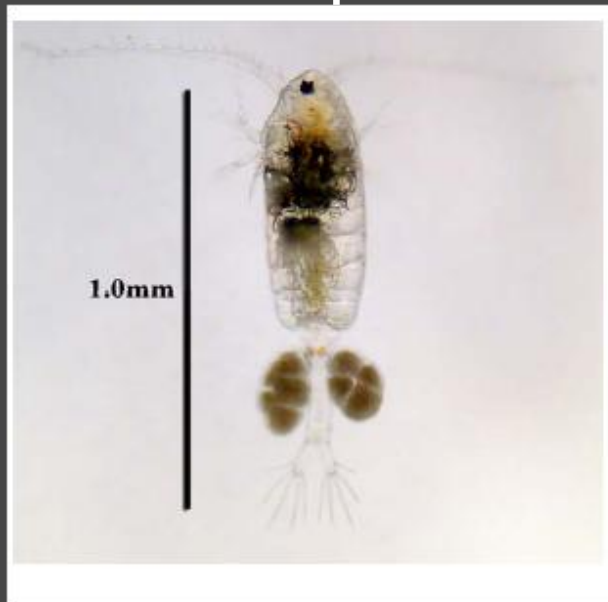
Phytoplankton



Pesticides



Zooplankton



Fish



Delta Smelt
Picture
fws.gov

Eurytemora affinis

Calanoid Copepod

Native Species

Dominant during winter



Pseudodiaptomus forbesi

Calanoid Copepod

Introduced Species

Dominant during summer



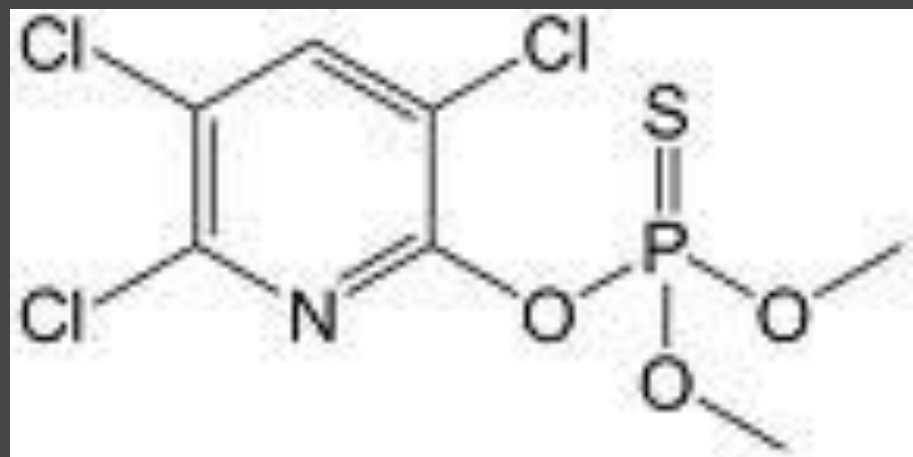
Chlorpyrifos

Organophosphate Pesticide

Broad spectrum insecticide

nervous system → inhibiting the
breakdown of acetylcholine →
excitation of neural cells →
neurotoxicity and death

Variety of uses including
agriculture, recreational,
wood treatment



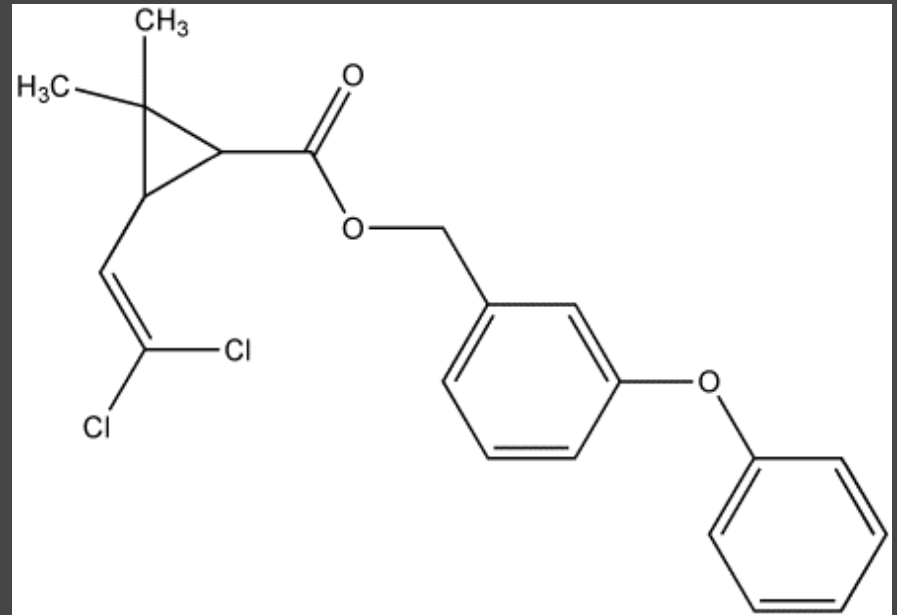
Permethrin and Bifenthrin

Pyrethroid Pesticides

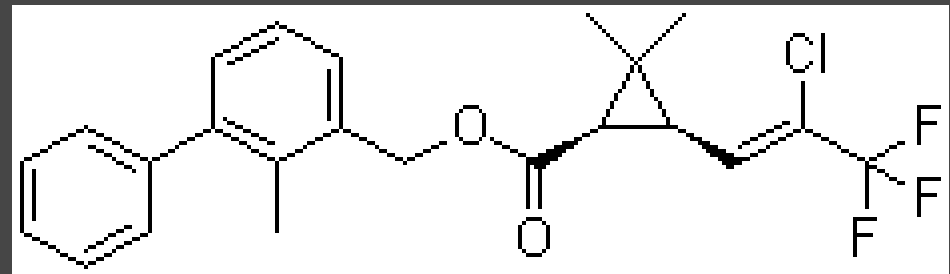
Broad spectrum insecticide

nervous system → interferes with sodium channels to disrupt neurons → muscle spasms, paralysis and death

Variety of uses privately and commercially including agriculture and in pharmaceutical treatment



Permethrin



Bifenthrin

Materials/Methods

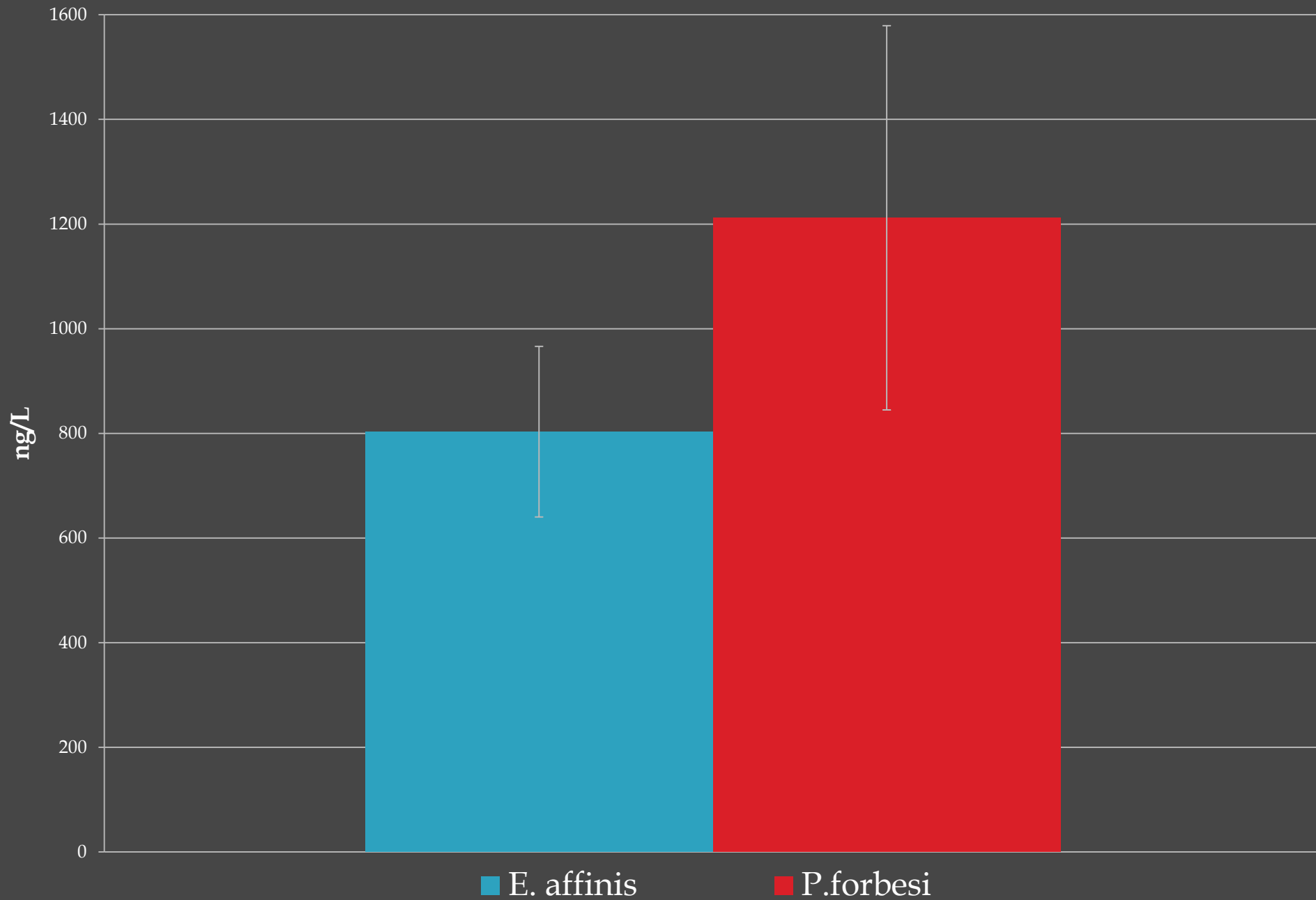
Temperature (°C)	20 \pm 0.1
Salinity (ppt)	1-2
pH	8 \pm 0.1
Control Survival	>80%
Beaker Size (mL)	600
Test Solution Volume (mL)	500
Life Stage	Juvenile
# of Copepods	20
# of replicates	3
# of concentrations	6
Feeding regime	1x/24 h
Test Duration	96 h



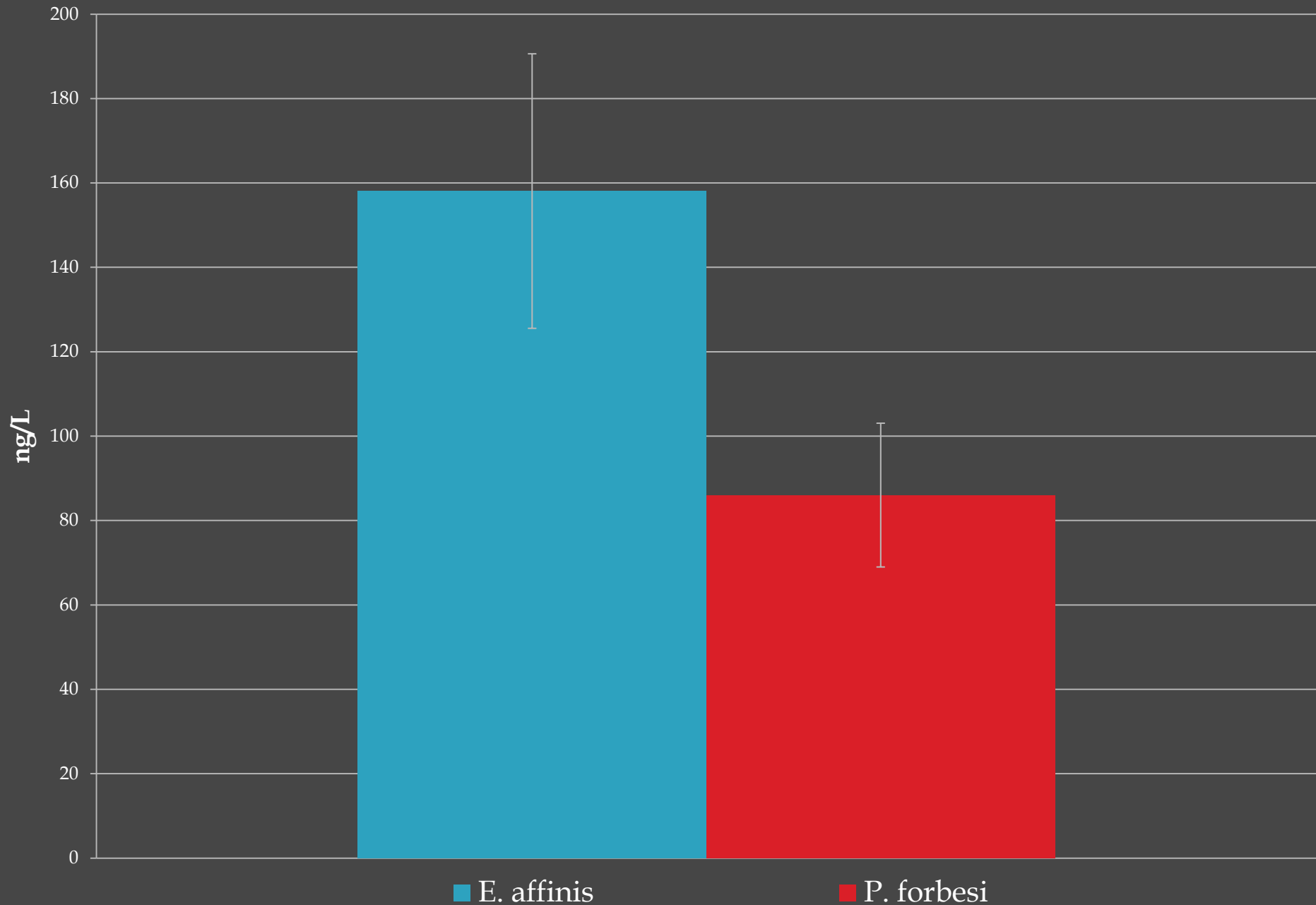
Test Concentrations (ng/L)

Chlorpyrifos	Permethrin	Bifenthrin
Vehicle Control	Vehicle Control	Vehicle Control
300	50	4
600	75	8
900	100	16
1200	125	32
1500	150	64

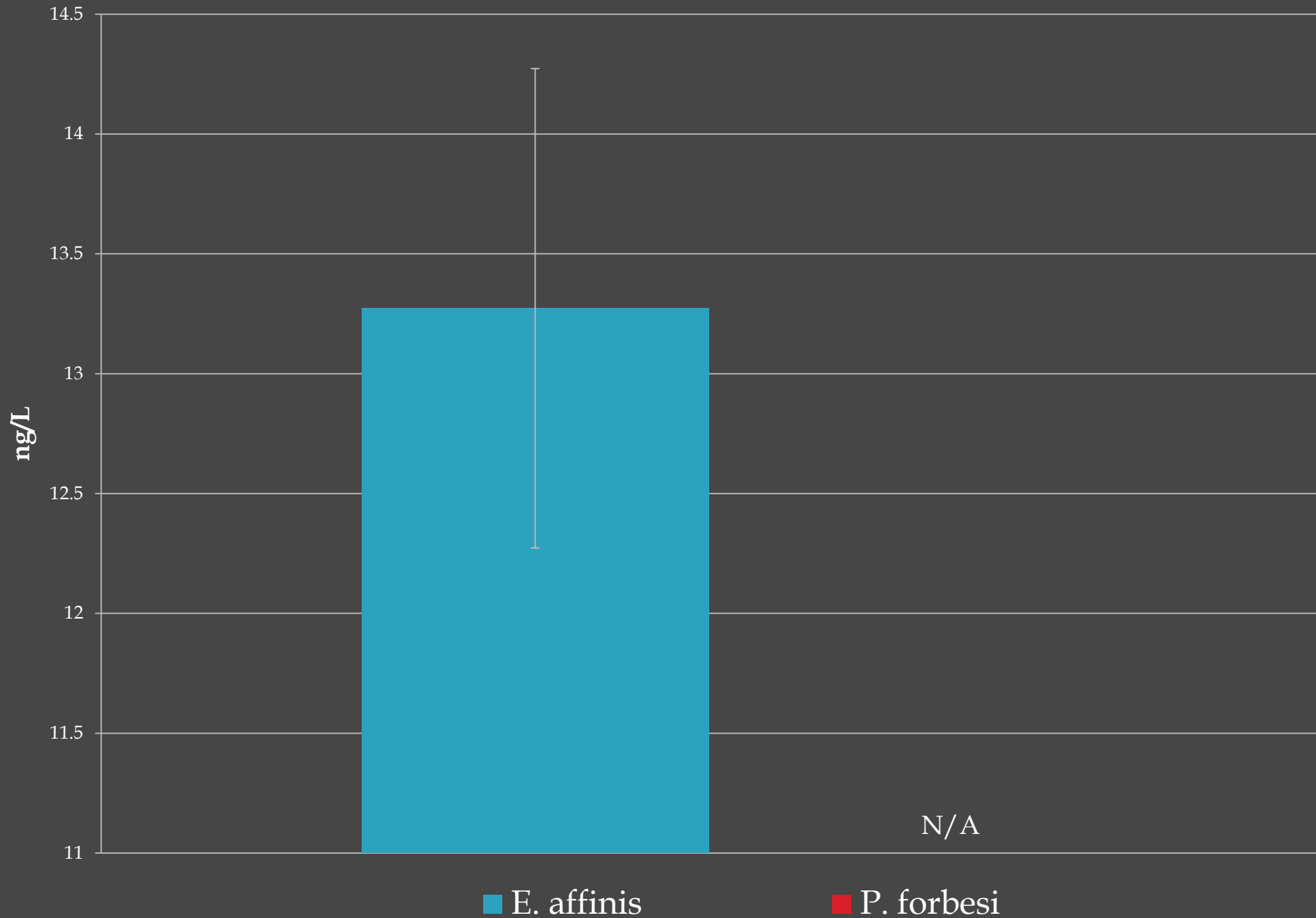
Comparison of 96hr LC 50 Values of Chlorpyrifos



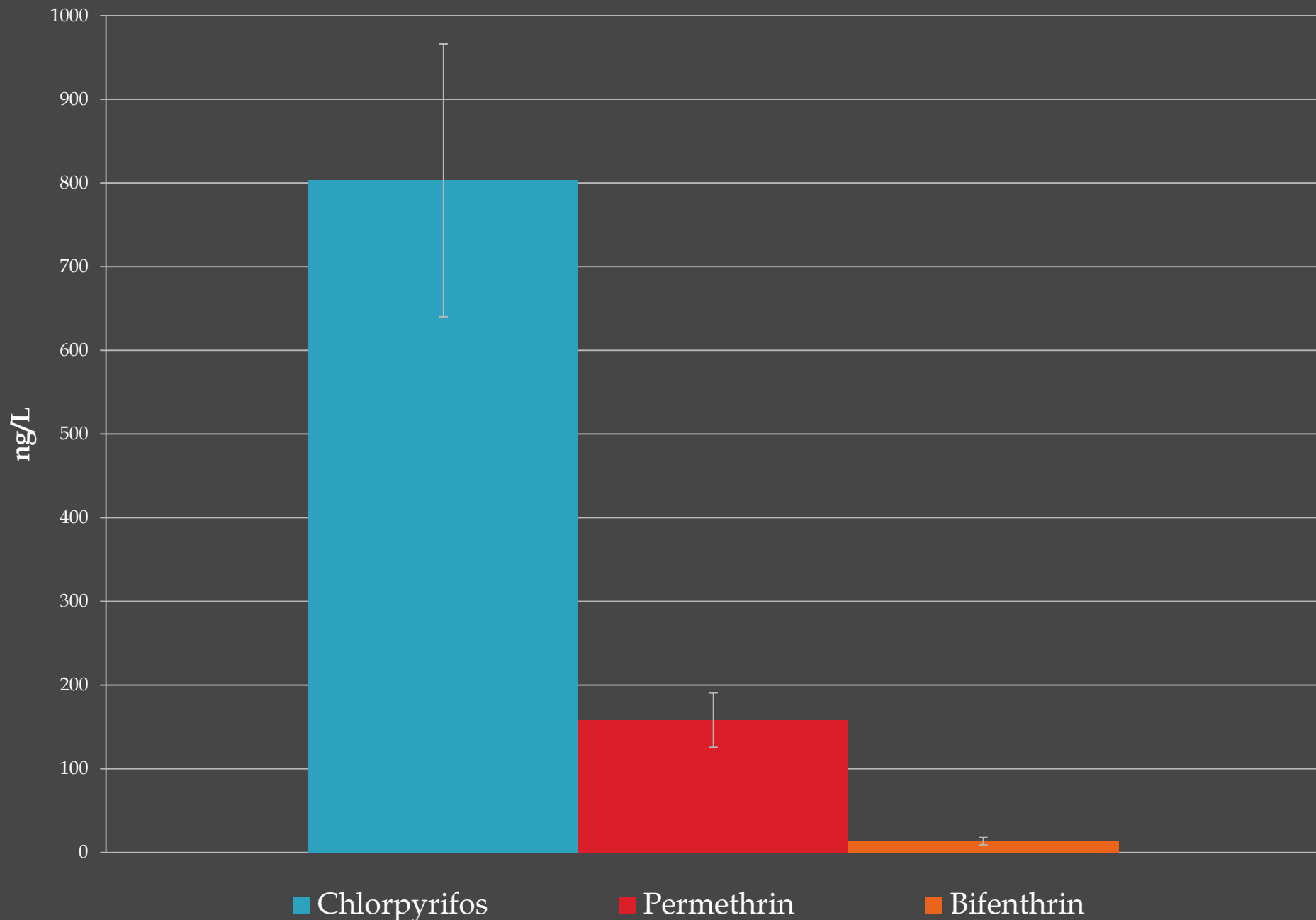
Comparison of 96hr LC50 Values for Permethrin



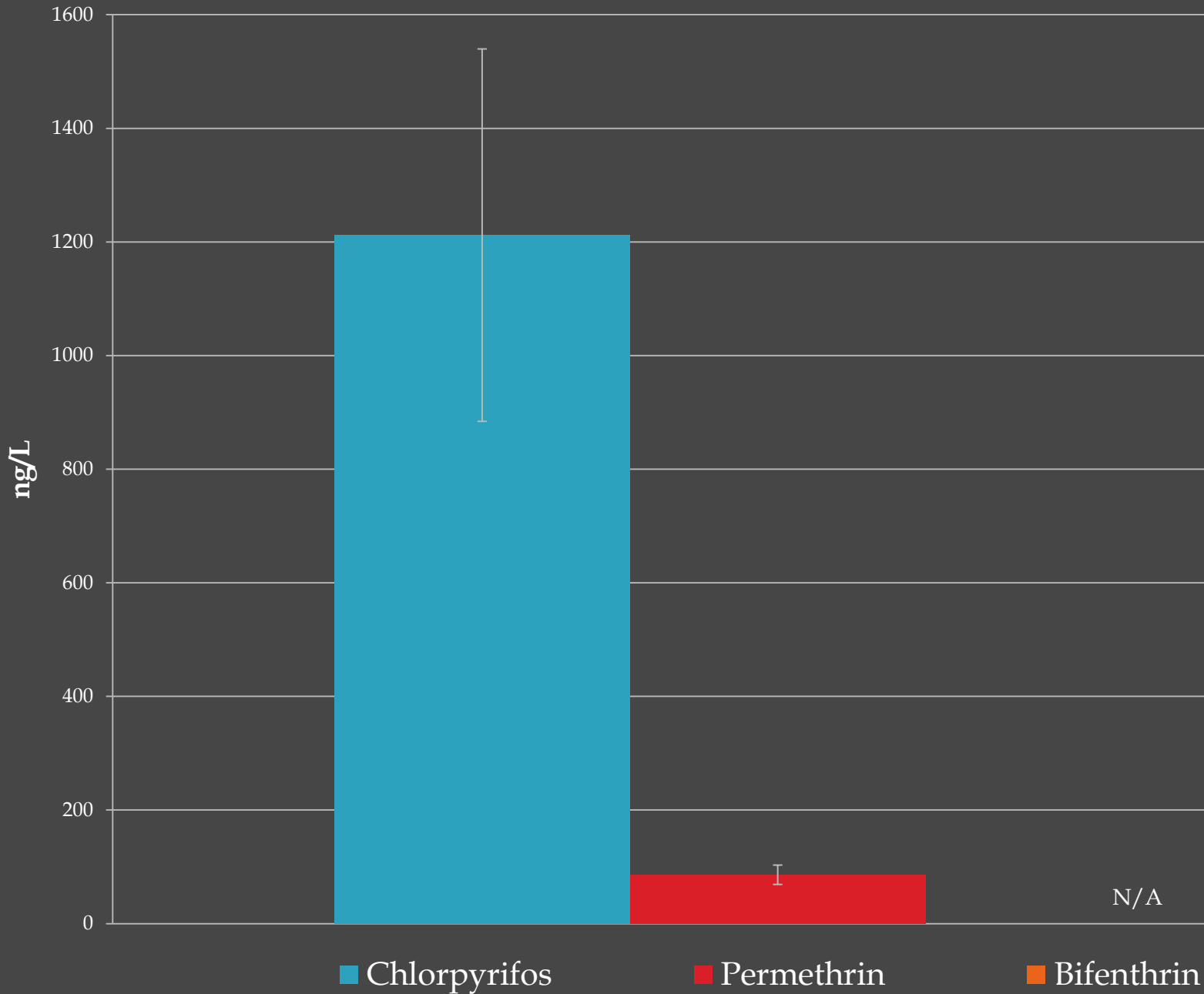
Comparison of 96hr LC 50 Values for Bifenthrin



Eurytemora affinis 96 hr LC 50 Values



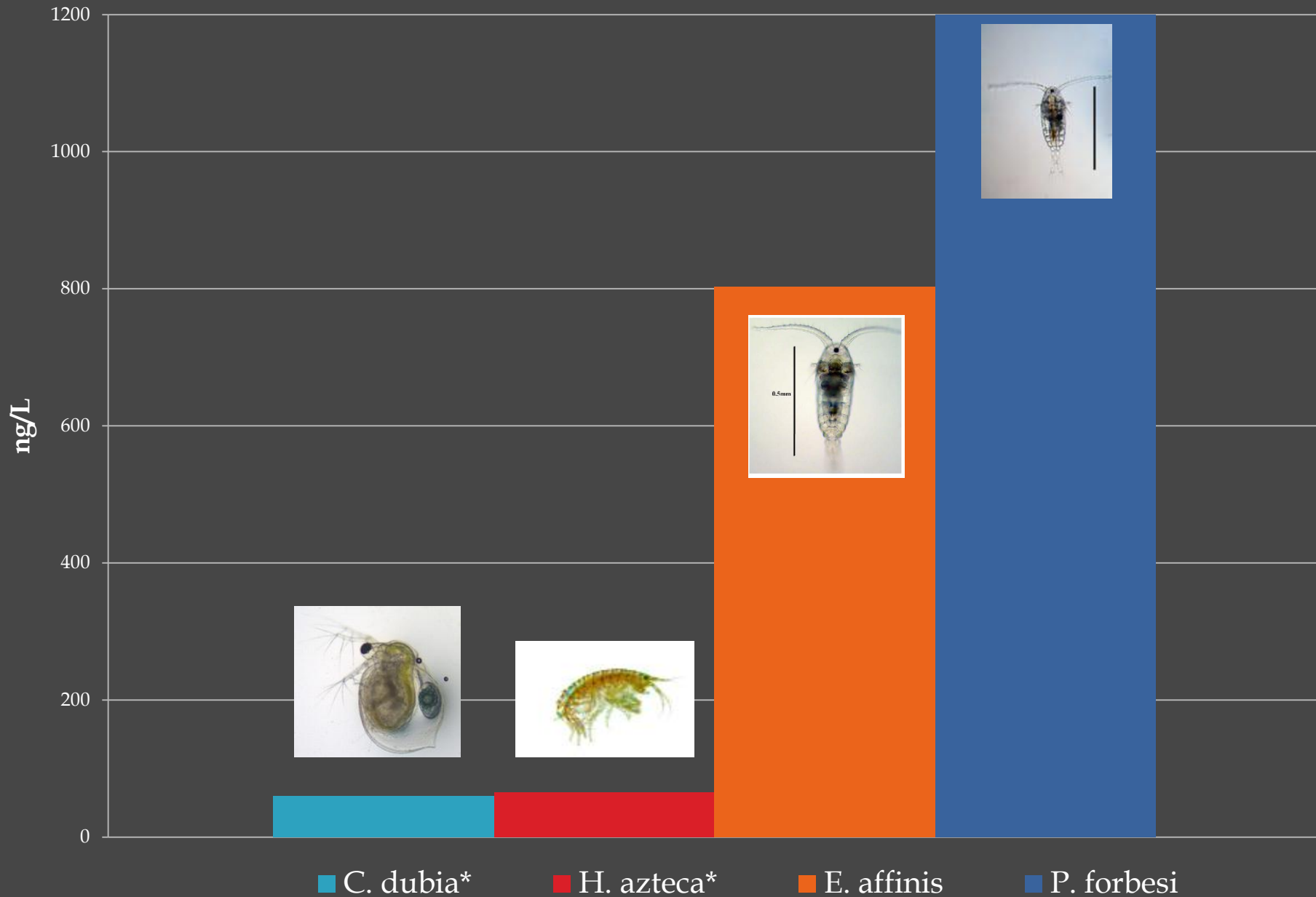
Pseudodiaptomus forbesi 96hr LC 50 Values



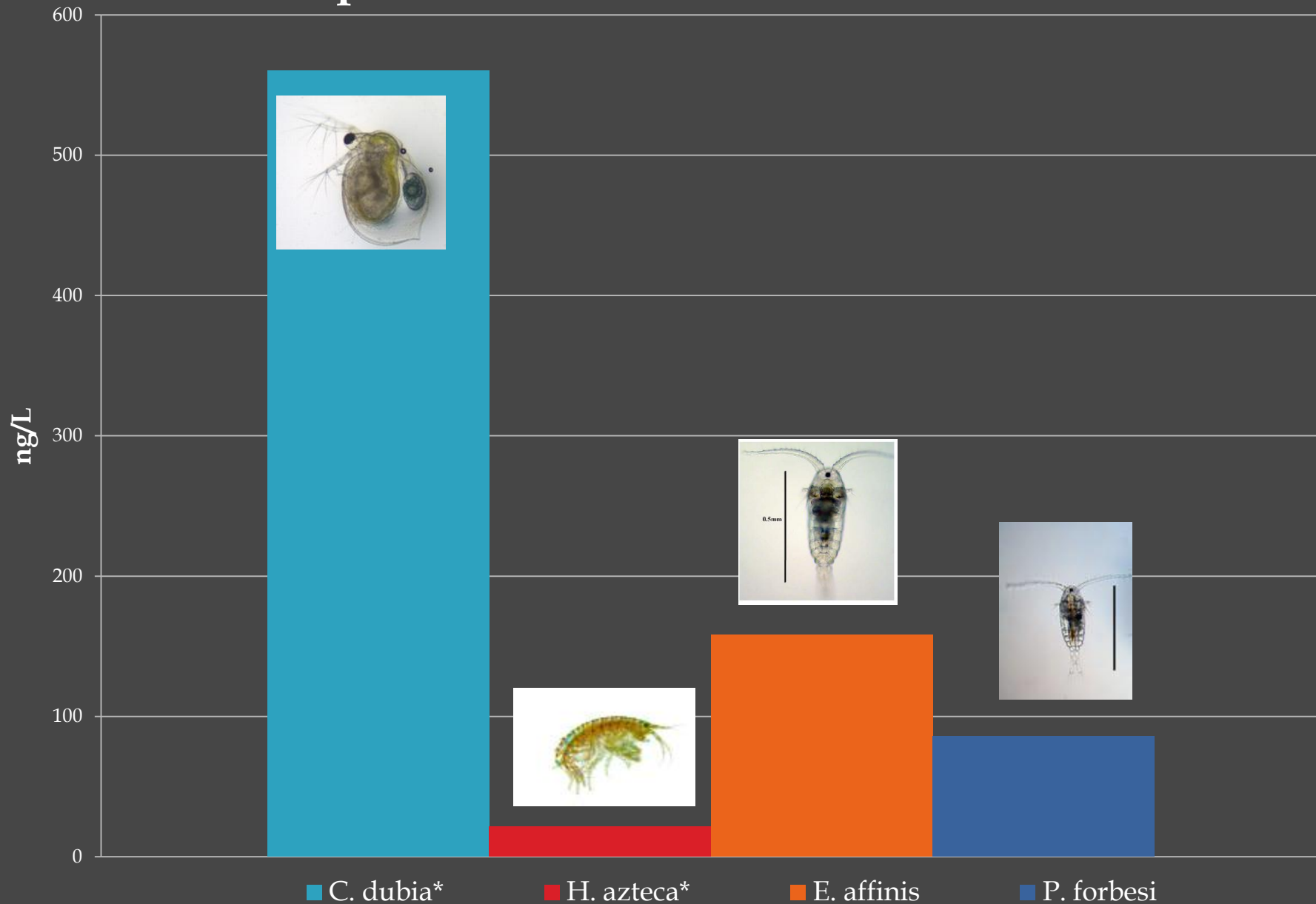
Results:Summary

ng/L (parts per trillion)	<i>E. affinis</i>	<i>P. forbesi</i>
Bifenthrin	13.273 (8.80,17.60)	N/A
Permethrin	158.079 (125.55,175.99)	86.028 (68.99,100.77)
Chlorpyrifos	803.196 (640.17,926.41)	1211.95 (884.18,1579.12)

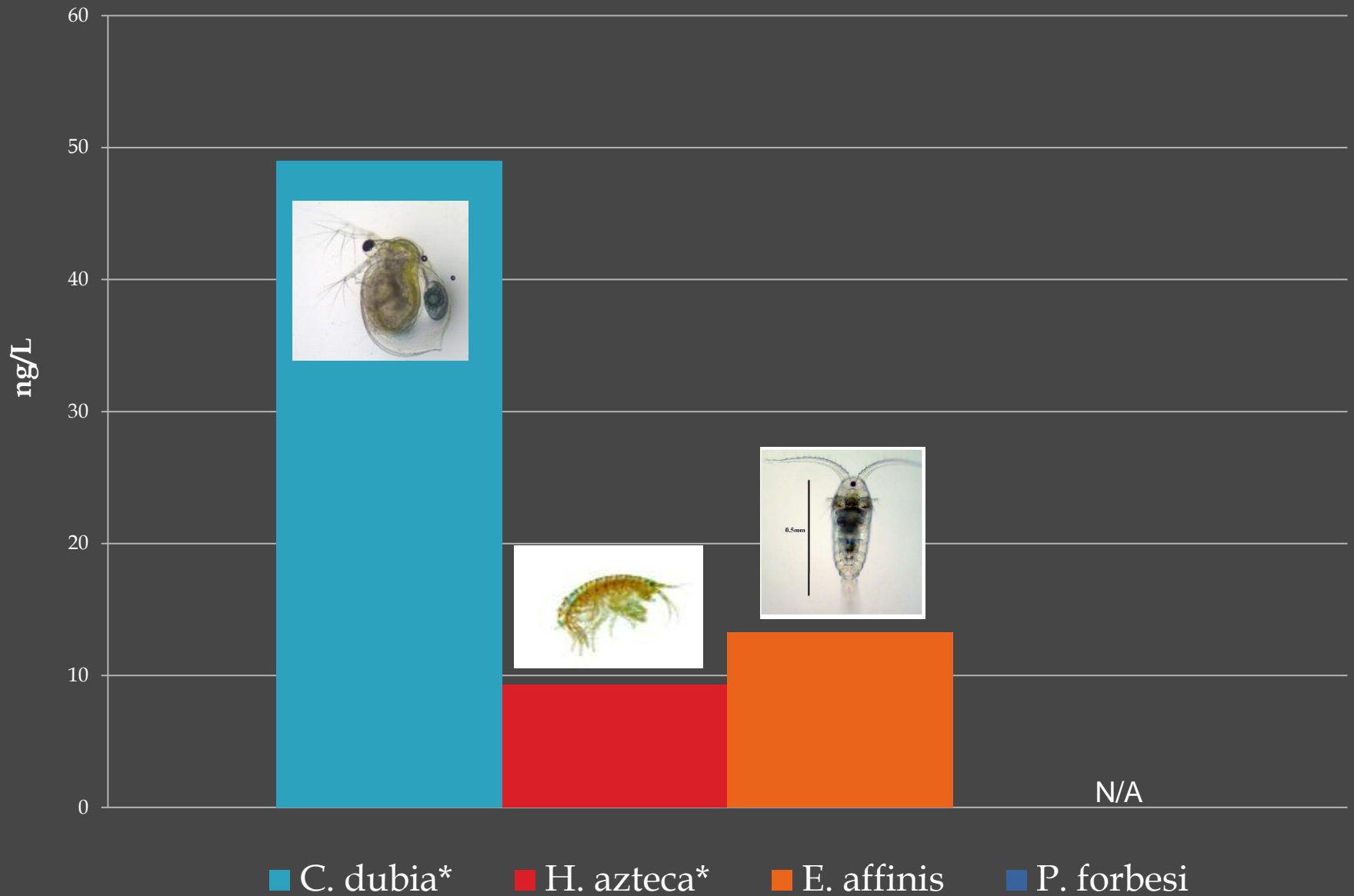
Comparison of 96hr LC 50 Values for Chlorpyrifos



Comparison of 96hr LC50 Values for Permethrin



Comparison of 96hr LC 50 Values for Bifenthrin



Source: Yang et al 2006, Anderson et al 2006

Summary

Sensitivity to pesticides varies between species

- ▣ *E. affinis* is more sensitive to Chlorpyrifos (OP) than *P. forbesi*
- ▣ *P. forbesi* is more sensitive to Permethrin (PY) than *E. affinis*

Sensitivity of pesticides to copepods varies on pesticide type

- ▣ *E. affinis* and *P. forbesi* may be more sensitive to pyrethroids (PY) in comparison to organophosphate (OP) pesticides

Pesticide Specific Sensitivity

Sources of variance between pesticides

- ▣ Differ modes of action
Ex: PY and sodium channel vs OP and enzyme
- ▣ Differ in shapes
Ex: Bifenthrin and fluorine vs. Permethrin and chlorine
- ▣ Other chemical characteristics
Ex: Solubility in water, half -life, etc

Pesticide regime shift

- ▣ Early 2000s- shift from OP to PY
 - POD started early 2000s

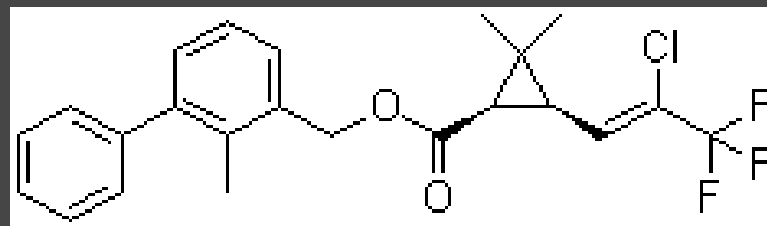
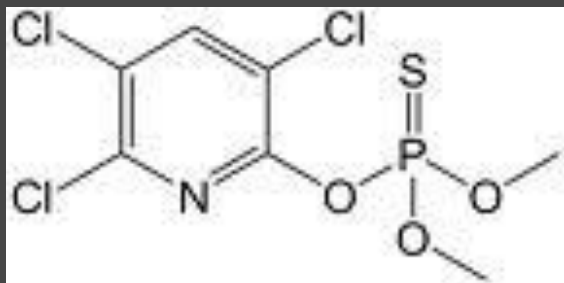
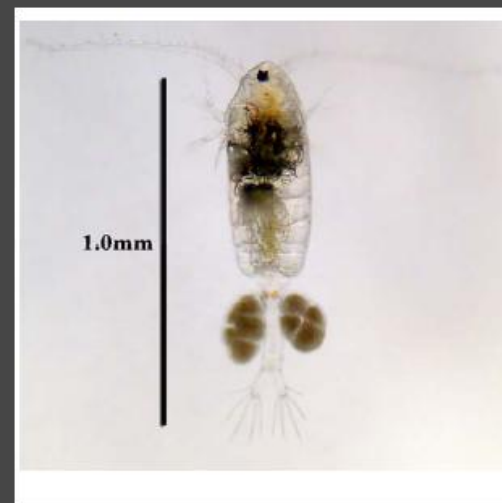
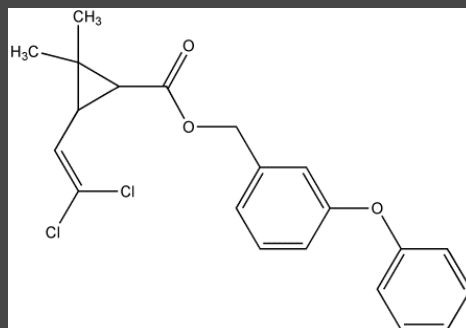
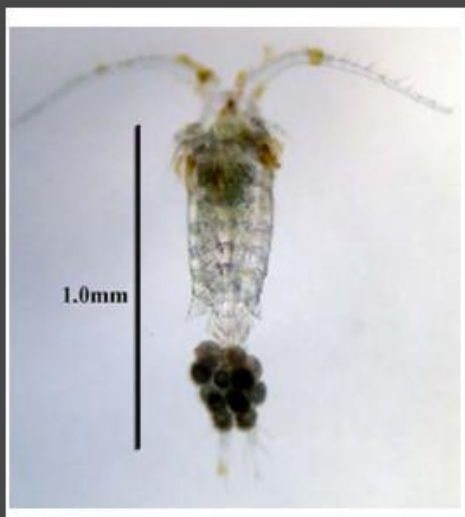
Conclusions

- ▣ Species specific differences in pesticide exposure
 - Between species that occupy same/ different niches
 - Testing on ecologically relevant species
- ▣ Different classes of pesticides effect species differently
- ▣ Pesticide regime shift may be a source of decline for zooplankton populations and POD

Future Directions

- ▣ Chronic effects
 - Current levels may not be high enough for acute toxicity, but what are the chronic effects?
 - ▣ Reproduction
 - ▣ Population dynamics
 - ▣ Shift in community composition
- ▣ Interactions with other contaminants
- ▣ Changes in abiotic factors
 - Global Climate Change
 - ▣ Temperature, pH , Salinity

Questions?



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Species Specific Sensitivity

Sources of variance between test species

- ▣ *E. affinis* and *P. forbesi* are dominant at different times in the year
- ▣ Prefer different abiotic ranges

Sources of variance between previous studies

- ▣ *E. affinis* and *P. forbesi* are in a completely different taxonomic group than *C. dubia* and *H. azteca*
- ▣ Occupy different niches
 - ex. *H. azteca* is a benthic dweller, *E. affinis* and *P. forbesi* are pelagic
- ▣ Different sizes
 - ex: ~60mm (*H. azteca*), ~1mm (*C. dubia*, *E. affinis*, *P. forbesi*)
- ▣ Conducted under different conditions
 - ex: *H. azteca* conducted with sediment